

CLAIMS

[C001] 1. A method of forming a waveguide comprising a core region, a cladding region, and an index contrast region situated therebetween, the method comprising:

depositing a polymerizable composite on a substrate to form a layer,

patterning the layer to define an exposed area and an unexposed area of the layer,

irradiating the exposed area of the layer, and

volatilizing the uncured monomer to form the waveguide, wherein the polymerizable composite comprises a polymer binder and sufficient quantities of an uncured monomer to diffuse into the exposed area of the layer and form the index contrast region.

[C002] 2. The method of claim 1, wherein the polymer binder comprises at least one of an acrylate polymer, a polyester, a polyimide, a polycarbonate, a polysulfone, a polyether ketone, and combinations thereof.

[C003] 3. The method of claim 1, wherein the polymer binder comprises an acrylate polymer comprising at least one of a poly(methyl methacrylate), poly(tetrafluoropropyl methacrylate), poly(2,2,2-trifluoroethyl methacrylate), copolymers comprising structural units derived from an acrylate polymer, and combinations thereof.

[C004] 4. The method of claim 1, wherein the uncured monomer comprises at least one of an acrylic monomer, a cyanate monomer, a vinyl monomer, an epoxide-containing monomer, and combinations thereof.

[C005] 5. The method of claim 1, wherein the uncured monomer comprises at least one of benzyl methacrylate, 2,2,2-trifluoroethyl methacrylate, tetrafluoropropyl methacrylate, methyl methacrylate, 3-4-epoxycyclohexylmethyl-3,4-epoxycyclohexane carboxylate, bisphenol A diglycidyl ether, bisphenol F diglycidyl ether, styrene, allyl diglycol carbonate, and cyanate ester.

[C006] 6. The method of claim 1, wherein irradiating the exposed area of the layer comprises irradiating the exposed area with ultraviolet radiation.

[C007] 7. The method of claim 1, wherein patterning the layer comprises patterning the layer using a gray scale mask.

[C008] 8. The method of claim 1 wherein patterning comprises patterning the layer to define at least one curve.

[C009] 9. The method of claim 1 wherein patterning is performed in a manner such that the unexposed area includes the core region.

[C010] 10. The method of claim 9 wherein the polymerizable composite comprises a polysulfone/epoxy blend.

[C011] 11. The method of claim 9 wherein patterning is performed in a manner such that the exposed area further includes a diffusion source region.

[C012] 12. The method of claim 1 wherein patterning is performed in a manner such that the exposed area includes the core region.

[C013] 13. The method of claim 11 wherein the polymerizable composite comprises an acrylic/epoxy blend.

[C014] 14. The method of claim 13 wherein polymerizable composite includes a concentration of at least about 25% uncured monomer.

[C015] 15. The method of claim 13 wherein polymerizable composite includes a concentration of at least about 40% uncured monomer.

[C016] 16. A method of forming a waveguide comprising a core region, a cladding region, and an index contrast region situated therebetween, the method comprising:

providing a polymerizable composite comprising a polymer binder and an uncured monomer,

depositing the polymerizable composite on a substrate to form a layer,

patterning the layer to define an exposed area and an unexposed area of the layer, one portion of the unexposed area comprising the core region and another portion of the unexposed area comprising a diffusion source region,

irradiating the exposed area of the layer, and

volatilizing the uncured monomer to form the waveguide and index contrast region.

[C017] 17. The method of claim 16, wherein the polymer binder comprises at least one of an acrylate polymer, a polyester, a polyimide, a polycarbonate, a polysulfone, a polyether ketone, and combinations thereof.

[C018] 18. The method of claim 16, wherein the polymer binder comprises an acrylate polymer comprising at least one of a poly(methyl methacrylate), poly(tetrafluoropropyl methacrylate), poly(2,2,2-trifluoroethyl methacrylate), copolymers comprising structural units derived from an acrylate polymer, and combinations thereof.

[C019] 19. The method of claim 16, wherein the uncured monomer comprises at least one of an acrylic monomer, a cyanate monomer, a vinyl monomer, an epoxide-containing monomer, and combinations thereof.

[C020] 20. The method of claim 16, wherein the uncured monomer comprises at least one of benzyl methacrylate, 2,2,2-trifluoroethyl methacrylate, tetrafluoropropyl methacrylate, methyl methacrylate, 3-4-epoxycyclohexylmethyl-3,4-epoxycyclohexane carboxylate, bisphenol A diglycidyl ether, bisphenol F diglycidyl ether, styrene, allyl diglycol carbonate, and cyanate ester.

[C021] 21. The method of claim 16, wherein irradiating the exposed area of the layer comprises irradiating the exposed area with ultraviolet radiation.

[C022] 22. The method of claim 16, wherein patterning the layer comprises patterning the layer using a gray scale mask.

[C023] 23. The method of claim 16, wherein patterning comprises defining the diffusion source region adjacent to the index contrast region.

[C024] 24. The method of claim 23 wherein at least one end portion of the diffusion source region is situated further from the core region than a center portion of the diffusion source region.

[C025] 25. The method of claim 24 wherein the diffusion source region is patterned to form an adiabatic mode-converter.

[C026] 26. The method of claim 16, wherein the diffusion source region comprises at least two diffusion source regions.

[C027] 27. The method of claim 26, wherein the at least two diffusion source regions include diffusion source regions situated on opposing sides of the core region.

[C028] 28. The method of claim 27, wherein the at least two diffusion source regions further include multiple diffusion source regions situated on one side of the core region.

[C029] 29. The method of claim 26, wherein the at least two diffusion source regions include multiple diffusion source regions situated on one side of the core region.

[C030] 30. The method of claim 29, wherein the multiple diffusion source regions are each adjacent to the index contrast region.

[C031] 31. The method of claim 29, wherein at least one of the multiple diffusion source regions is situated between the core region and at least one other of the multiple diffusion source regions.

[C032] 32. The method of claim 26, wherein the at least two diffusion source regions comprise at least one device selected from the group consisting of Omni reflectors, Bragg gratings, directional couplers, and combinations thereof.

[C033] 33. A method of forming a waveguide comprising a cladding region, a core region, and a scattering region, the method comprising:

providing a polymerizable composite comprising a polymer binder and an uncured monomer,

depositing the polymerizable composite on a substrate to form a layer,

patterning the layer to define an exposed area and an unexposed area of the layer, one area of the exposed and the unexposed areas comprising the cladding region, and another area of the exposed and the unexposed areas comprising the core region and the scattering region,

irradiating the exposed area of the layer, and

volatilizing the uncured monomer to form the waveguide.

[C034] 34. The method of claim 33, wherein patterning the layer comprises patterning the layer using a gray scale mask.

[C035] 35. The method of claim 33, wherein the polymerizable composite comprises sufficient quantities of the uncured monomer to diffuse into the exposed area of the layer and form an index contrast region between the cladding region and the core region during volatilizing.

[C036] 36. The method of claim 33, wherein the polymer binder comprises at least one of an acrylate polymer, a polyester, a polyimide, a polycarbonate, a polysulfone, a polyether ketone, and combinations thereof.

[C037] 37. The method of claim 33, wherein the uncured monomer comprises at least one of an acrylic monomer, a cyanate monomer, a vinyl monomer, an epoxide-containing monomer, and combinations thereof.

[C038] 38. The method of claim 33 wherein patterning to define the scattering region comprises defining an optical termination.

[C039] 39. The method of claim 33 wherein patterning to define the scattering region comprises defining two scattering regions situated on opposite sides of the core region.

[C040] 40. The method of claim 33 wherein the waveguide comprises an array of waveguides, the core region comprises two core regions, and wherein patterning to define the core and scattering regions comprises defining the scattering region between the core regions.

[C041] 41. A waveguide comprising a polymer layer comprising

a core region,

a cladding region,

and an index contrast region situated therebetween,

wherein the index contrast region has a lower index of refraction than that of the core and cladding regions.

[C042] 42. The waveguide of claim 41, wherein the waveguide comprises at least one of an acrylate polymer, a polyester, a polyimide, a polycarbonate, a polysulfone, a polyether ketone, and combinations thereof.

[C043] 43. The waveguide of claim 41, wherein the waveguide comprises an acrylate polymer comprising at least one of a poly(methyl methacrylate), poly(tetrafluoropropyl methacrylate), poly(2,2,2-trifluoroethyl methacrylate), copolymers comprising structural units derived from an acrylate polymer, and combinations thereof.

[C044] 44. The waveguide of claim 41 wherein the core region comprises at least one curve.

[C045] 45. A waveguide comprising a polymer layer comprising

a core region,

a diffusion source region,

a cladding region having a lower index of refraction than that of the core and diffusion source regions, and

an index contrast region situated between the core region and the diffusion source region and having a lower index of refraction than that of the cladding region.

[C046] 46. The waveguide of claim 45, wherein the waveguide comprises at least one of an acrylate polymer, a polyester, a polyimide, a polycarbonate, a polysulfone, a polyether ketone, and combinations thereof.

[C047] 47. The waveguide of claim 45, wherein the waveguide comprises an acrylate polymer comprising at least one of a poly(methyl methacrylate), poly(tetrafluoropropyl methacrylate), poly(2,2,2-trifluoroethyl methacrylate), copolymers comprising structural units derived from an acrylate polymer, and combinations thereof.

[C048] 48. The waveguide of claim 45, wherein the diffusion source region is situated adjacent to the index contrast region.

[C049] 49. The waveguide of claim 48 wherein at least one end portion of the diffusion source region is situated further from the core region than a center portion of the diffusion source region.

[C050] 50. The waveguide of claim 49 wherein the diffusion source region is patterned to form an adiabatic mode-converter.

[C051] 51. The waveguide of claim 45, wherein the diffusion source region comprises at least two diffusion source regions.

[C052] 52. The waveguide of claim 51, wherein the at least two diffusion source regions include diffusion source regions situated on opposing sides of the core region.

[C053] 53. The waveguide of claim 52, wherein the at least two diffusion source regions further include multiple diffusion source regions situated on one side of the core region.

[C054] 54. The waveguide of claim 51, wherein the at least two diffusion source regions include multiple diffusion source regions situated on one side of the core region.

[C055] 55. The waveguide of claim 54, wherein the multiple diffusion source regions are each adjacent to the index contrast region.

[C056] 56. The waveguide of claim 55, wherein at least one of the multiple diffusion source regions is situated between the core region and at least one other of the multiple diffusion source regions.

[C057] 57. The waveguide of claim 51, wherein the at least two diffusion source regions comprise at least one device selected from the group consisting of Omni reflectors, Bragg gratings, directional couplers, and combinations thereof.

[C058] 58. A waveguide comprising a polymer layer comprising

a core region,

a scattering region, and

a cladding region having a lower index of refraction than that of the core and scattering regions.

[C059] 59. The waveguide of claim 58, further comprising an index contrast region between the cladding region and the core region, the index contrast region having a lower index of refraction than that of the cladding region.

[C060] 60. The waveguide of claim 58 wherein the scattering region comprises a comb shape.

[C061] 61. The waveguide of claim 58 wherein the scattering region comprises a pattern and location adapted for optical termination.

[C062] 62. The waveguide of claim 58 wherein the scattering region comprises two scattering regions situated on opposite sides of the core region.

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[C063] 63. The waveguide of claim 58 wherein the waveguide comprises an array of waveguides, the core region comprises two core regions, and the scattering region is situated between the core regions.